

IONIC REACTIONS

Four ions in solution

1. Redox reaction (look for two Roman Numerals) H_2O_2 , MnO_4^- , $\text{Cr}_2\text{O}_7^{2-}$, $\text{C}_2\text{O}_4^{2-}$, MnO_2 OR acidified or basic(alkaline) solutions

Solid potassium dichromate is added to an acidified solution of sodium iodide

A solution of potassium permanganate is mixed with an alkaline solution of sodium sulfite.

A solution of tin(II) chloride is added to a solution of iron(III) sulfate.

2. Precipitation (know solubility rules)

A saturated solution of barium hydroxide is mixed with a solution of iron(III) sulfate.

3. (a) Formation of a weak acid (one ion has to be H_3O^+ and the conjugate base of a weak acid)

A solution of hydrochloric acid is added to a sodium acetate solution.

Equal volumes of 0.10 M hydrochloric acid and 0.10 M sodium monohydrogen phosphate are mixed.

(b) Formation of a weak base (one ion has to be OH^- and conjugate acid of a weak base)

A solution of sodium hydroxide is added to ammonium chloride solution.

(c) Could be an acid or base solution added to a solid

Ammonium chloride crystals are added to a solution of sodium hydroxide.

4. Formation of a gas (two ions present: CO_3^{2-} or HCO_3^- , SO_3^{2-} and H_3O^+)

Hydrobromic acid solution is added to a solution of potassium hydrogen carbonate.

Excess hydrochloric acid solution is added to a solution of sodium sulfite.

Equal volumes of dilute equimolar solutions of sodium carbonate and hydrochloric acid are mixed.

Metal

1. Metal + ionic solution \rightarrow metal ion + metal from positive ion in ionic solution

Aluminum metal is added to a solution of copper(II) chloride.

2. Metal + Acid \rightarrow metal ion + H_2 + H_2O

exception: coinage metals(Ag, Cu and Au) will not produce $\text{H}_2(\text{g})$ look for dilute or concentrated nitric acid (NO or NO_2)

A strip of zinc is added to a solution of 6.0 M hydrobromic acid.

Copper metal is added to a dilute solution of nitric acid.

3. Active metal (group 1 and Ba, Ca, Sr) + H₂O → H₂ + strong base(ions)

Sodium metal is added to water.

Reactions with water

1. Metal oxide (base anhydride) + water → strong base(ions)

Solid sodium oxide is added to water.

2. Nonmetal oxide (acid anhydride) + water → oxoacid (weak-molecule strong-ions) NO REDOX

Drops of liquid dinitrogen trioxide are added to distilled water.

Sulfur trioxide gas is bubbled into water.

3. Nonmetal halide or nonmetalloxohalide + water → oxoacid and binary acid

Phosphorus (III) fluoride is added to water.

Phosphorus (V) oxotrichloride is added to water.

4. Soluble ionic compound + water → hydrolysis

- a) negative ion forms weak acid + OH⁻
- b) positive ion forms weak base + H₃O⁺

Sodium fluoride is added to water.

Potassium carbonate is added to water.

Methylamine nitrate is added to water.

5. Metal hydride + water → H₂ + strong base(ions)

Calcium hydride is added to water.

6. Metal nitride + water → ammonia(NH₃) + metal ion + OH⁻ NO REDOX

Water is added to a solid sample of barium nitride.

Water is added to a solid sample of magnesium nitride.

7. Metal amide + water → metal ion + OH⁻ + NH₃

Water is added to a solid sample of sodium amide.

Complex ion formation

1. Common ligands (NH₃ ammine, OH⁻ hydroxo, CN⁻ cyano, SCN⁻ thiocyanate)

2. Look for excess or concentrated OH⁻ or NH₃

3. Exception: $\text{Al}(\text{OH})_4^-$

4. Central ion is transition ion except for Al^{3+}

A concentrated solution of ammonia is added to a solution of copper (II) chloride.

An excess of nitric acid solution is added to a solution of tetraamminecopper (II) sulfate.

A drop of potassium thiocyanate is added to a solution of iron (III) chloride.

Sodium hydroxide solution is added to a precipitate of aluminum hydroxide.

General Reactions

1. Metal oxoanion \rightarrow metal oxide + nonmetal oxide NO REDOX(No ions)

A solid sample of calcium phosphate is heated.

2. Metal oxide + nonmetal oxide \rightarrow metal oxoanion NO REDOX

Sulfur dioxide gas is passed over solid calcium oxide

3. Combustion reaction (O_2)

- a) organic acid, alcohol and hydrocarbon
- b) element

Ethanoic acid is completely combusted in oxygen.

Magnesium turnings are combusted in oxygen.

4. Acid-base reaction

Acetic acid solution is added to a saturated solution of barium hydroxide.

5. Gas passed over a solid (REDOX REACTION and NO IONS)

Hydrogen gas is passed over hot iron (III) oxide.

Solid copper (II) oxide is heated in excess carbon monoxide.

6. Synthesis reaction (NO IONS)

Magnesium metal is combusted in nitrogen gas.

7. Hydrogen sulfide gas is a sulfide generator

Gaseous hydrogen sulfide is bubbled through a solution of nickel (II) nitrate.

8. Halogen is added to a metal halide solution.

Chlorine gas is bubbled into a solution of sodium bromide.